Runoff Estimation and Design Criteria for the Gilsonite Storage Area and Access-Haul Road, Ziegler Chemical and Mineral Corporation, Ute-32 Mine (ACT/047/008).

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Purpose -

The purpose of this study is to insure adequate drainage structures for the gilsonite storage pad and the access-haul road of Ziegler Chemical and Mineral Corporation's Ute-32 Gilsonite Mine.

Site:

The Ute-32 Mine is located in the Southeast quarter of Section 32, Township 11 South, Range 25 East, SLBM, Uintah County, Utah. A vertical shaft will disturb approximately 100 square feet (10 ft x 10 ft) and the gilsonite storage pad will disturb an area of 1.0372 acres. An upgraded prexisting access road will disturb approximately 1.33 acres of State land (19.30.2 ft x 30 ft) and 4.30 acres of BLM administered land (6241.4 ft x 30 ft). The road will cross Sections 32, 33, and 28, Township 11 South, Range 25 East, SLBM. Maps of the area are located in the appendix.

Procedure:

Area runoff and peak flow can be estimated for storms of a particular cyclic frequency. The road and surface facilities will be used for approximately four years, and then be reclaimed. Therefore, drainage facilities should be designed to withstand the maximum flood expected to occur within a four year period.

Depth of precipitation for storms of 5, 10, and 100 year return periods were taken from maps compiled by the U.S. Department of Commerce. Probabilities of occurence for these storms for a four year period are listed in the appendix. As there is no danger to life and little possibility of severe environmental damage if the drainage facilities fail, design will be based on a balance of sediment control and minimum disturbance caused by construction.

Area runoff was computed by the Soil Conservation Service Runoff Curve Number Technique and peak flow was computed by the Hydrograph Synthesis Technique. Drainage design is based on methods used by the Utah State Dept. of Highways. Calculations are listed in the appendix.

DATA:

Watershed draining onto gilsonite storage area	0.355 mi^2
Watershed draining onto road	1.42 mi^2
Length of watershed draining onto road (L)	13,750 ft
Length of watershed draining onto gilsonite storage area (L)	6,000 ft
Slope of watershed in dimentionless ratio draining onto gilsonite storage	0.07
Slope of watershed in dimentionless ratio draining onto road	0.06
SCS Weighted Curve Number for Watershed	79
Manning's Roughness Coefficent (n) for blade cut diversion ditch	0.025
Soil Group	C
Precipitation, 5 year 24 hour storm	1.4 inches
Precipitation, 10 year 24 hour storm	1.6 inches
Precipitation, 100 year 24 hour storm	2.4 inches

Results:

ITEM	AREA OF IMPACT	
	Gilsonite Storage Area	Access-Haul Road
Area Runoff (Q) 5 yr 24 hr storm	0.214 inches	0.214 inches
Area Runoff (Q) 10 yr 24 hr storm	0.306 inches	0.306 inches
Area Runoff (Q) 100 yr 24 hr storm	0.771 inches	0.771 inches
Peak Runoff (qp) 5 yr 24 hr storm	182.0 cfs Probability of occurence	355.3 cfs in any four year period = 59%
Peak Runoff (qp) 10 yr 24 hr storm	260.3 cfs Probability of occurence	508.0 cfs in any four year period = 34%
Peak Runoff (qp) 100 yr 24 hr storm	655.8 cfs Probability of occurence	1,280.0 cfs in any four year period = 4%

Design:

1. Trapezoidal diversion channel for the gilsonite storage area designed from the 5 year, 24 hour precipitation event. *

   Assume:

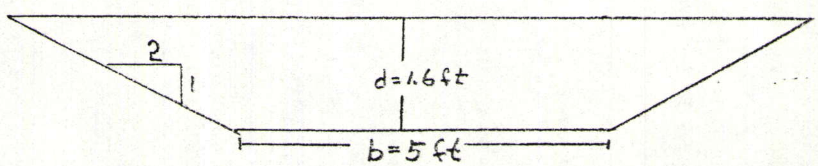
   qPeak = 182 cfs
   Manning's Roughness coeff.$^{(n)}$ = 0.025
   base width (b) = 5 ft.
   Slope of channel side (m) = 2:1
   Slope of hydraulic gradeline = 0.05

   Procedure:

   See Appendix

   Results:

   depth of channel (d) = 1.6 ft.



* Appears to be the most efficient and least costly.

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2. Trapezoidal diversion channel for the gilsonite storage area designed from the 10 year, 24 hour precipitation event.

Assume:

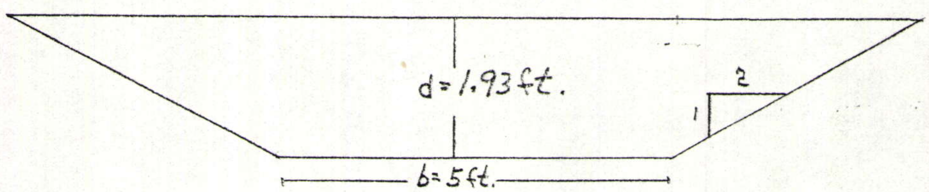
qpeak = 260.3 cfs
Manning's Roughness Coeff. (n) = 0.025
base width (b) =
Slope of channel side (m) = 2:1
Slope of hydraulic gradeline = 0.05

Procedure:

See Appendix

Results:

depth of channel (d) = 1.93 ft.



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3. Trapozoidal diversion channel for the gilsonite storage area designed runoff from the 100 year, 24 hour precipitation event.

Assume:

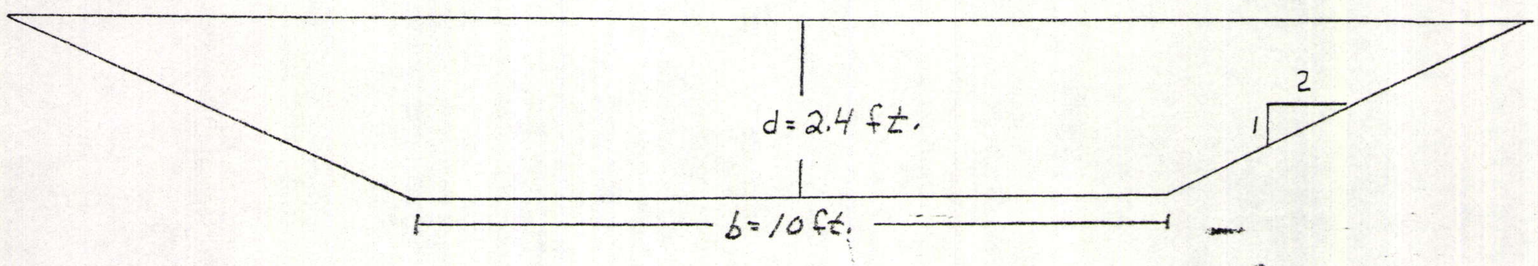
qpeak = 655.8 cfs
Manning's Roughness coeff. (n) = 0.025
base width (b) = 10 ft.
Slope of channel side (m) = 2:1
Slope of hydraulic gradeline = 0.05

Procedure:

See Appendix

Results:

depth of channel (d) = 2.4 ft.



Discussion & Recommendations:

The probability of occurence within any four year period for a storm with a return period of five years is 59 percent. Therefore, design based on peak runoff resulting from a five year storm has approximately a 59 percent chance of failure. Increasing the depth of the trapezoidal channel from 1.6 feet to 1.9 feet will increase the channel's capacity to handle the ten year storm, which has a probability of occurence of 34 percent in any four year period. Design based on the 100 year flood will give a probability of failure of only four percent, but construction will result in too much surface damage.

It is required that a diversion ditch be constructed on the south and east sides of the gilsonite storage area in such a manner as to control runoff resulting from the 10 year 24 hour precipitation event. It is recommended that a trapezoidal diversion ditch be constructed as designed herein. However, any design that will handle the flood resulting from the 10 year 24 hour precipitation event may be accepted. Excavated soil is to be stockpiled for regrading and reclamation when the area is no longer needed, and the diversion ditch is to be vegetated as soon as possible after construction. Any grass or grass mixture is acceptable.

The access-haul road will be drained with water-bars as not to channel runoff down the roadbed. As most of the road is on BLM administered land BLM specifications are to be followed.

PROCEDURE FOR ESTIMATION FLOW
IN AREA INCHES, AND PEAK FLOW
IN CUBIC FEET PER SECOND

Step. 1 Find Precipitation for the site from a rainfall frequency map.

Step. 2 Estimate Curve Number for Watershed.

Step. 3 Plug into SCS Runoff Equation.

$$Q_{(in)} = \frac{(P_{(in)} - 0.2S)^2}{P_{(in)} + 0.8\,S}, \quad S = \frac{1000}{cn} - 10$$

for $P \quad 0.2\,S$

Step. 4 Estimate time to peak runoff for watershed (Tp) by finding time of concentration by Kirpitch's Formula.

$$Tp = 0.7\,Tc$$

$$Tc\ (hrs) = 0.00013\ \frac{L^{0.77}}{S^{0.385}}$$

L= Length of basin area in feet, measured along the watercourse and in a direct line from the discharge point to the farthest point on the basin.

S= ratio in feet to "L" of the fall of the basin to the length, or approximately the average slope of the basin in dimentionless ratio.

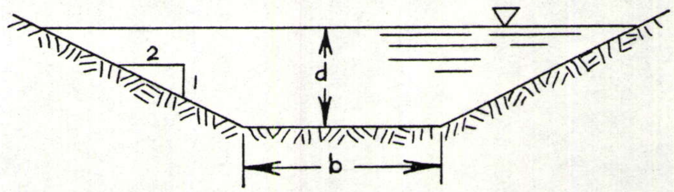
Step. 5 Estimate Peak Flow for Precipitation Event

$$qp\ (cfs) = 484\ \frac{Q(in)\ \ A\ (mi^2)}{Tp\ (hrs.)}$$

VALUES OF $b^{8/3}$

b	$b^{8/3}$	b	$b^{8/3}$
1	1.00	21	3360
2	6.35	22	3800
3	18.7	23	4280
4	40.3	24	4790
5	73.1	25	5340
6	119	26	5930
7	179	27	6560
8	256	28	7230
9	350	29	7940
10	464	30	8690
11	598	31	9840
12	755	32	10320
13	934	33	11200
14	1140	34	12130
15	1370	35	13110
16	1630	36	14160
17	1910	37	15176
18	2230	38	16320
19	7940	39	17466
20	2950	40	18732

Table 3-24: TRAPEZOIDAL CHANNEL
2:1 SIDE SLOPES



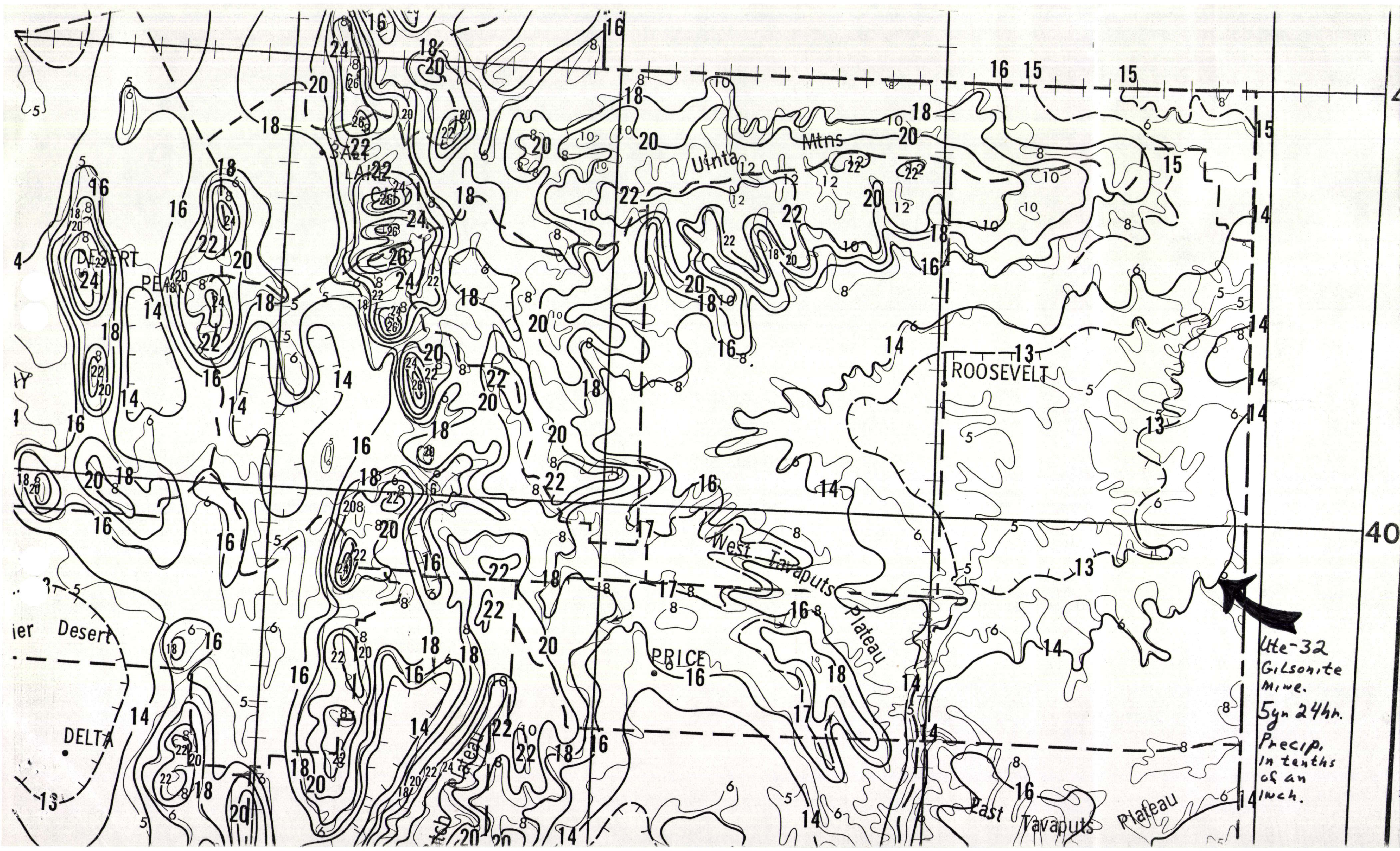
1. Calculate $K' = \dfrac{Qn}{b^{8/3}s^{1/2}}$.

2. Enter the table below at K' and find the corresponding value of d/b.

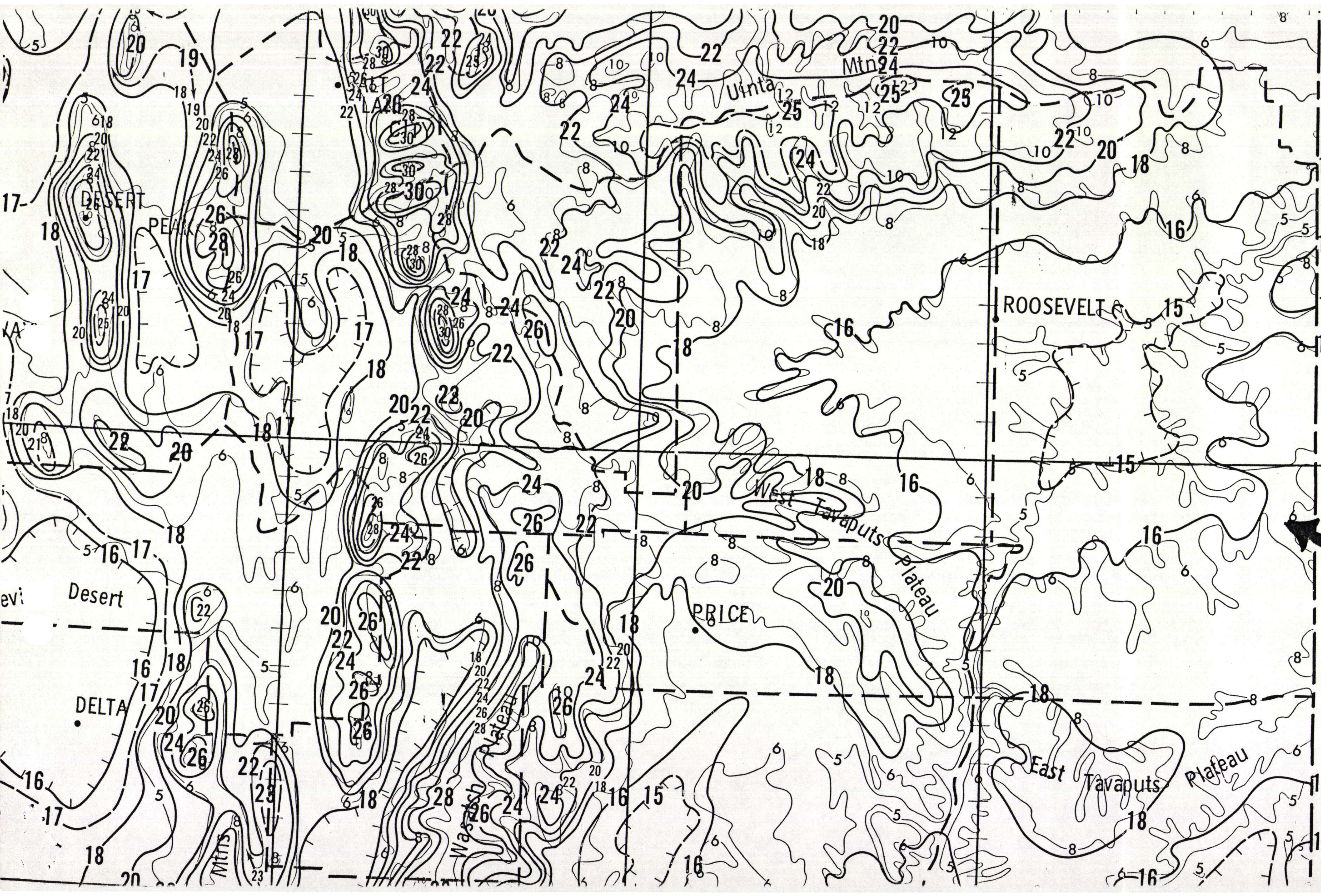
3. Calculate d = b(d/b).

Values of K' as a function of the ratio d/b.

d/b	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.20	.116	.127	.139	.150	.163	.176	.189	.203	.217	.232
0.30	.248	.264	.281	.298	.316	.334	.353	.372	.392	.413
0.40	.434	.456	.478	.501	.525	.549	.574	.599	.625	.652
0.50	.679	.707	.736	.765	.795	.826	.857	.889	.922	.956
0.60	.990	1.02	1.06	1.10	1.13	1.17	1.21	1.25	1.29	1.33
0.70	1.37	1.41	1.46	1.50	1.54	1.59	1.63	1.68	1.73	1.78
0.80	1.83	1.88	1.93	1.98	2.03	2.08	2.14	2.19	2.25	2.31
0.90	2.36	2.42	2.48	2.54	2.60	2.66	2.73	2.79	2.85	2.92
1.00	2.99	3.05	3.12	3.19	3.26	3.33	3.40	3.48	3.55	3.62
1.10	3.70	3.78	3.85	3.93	4.01	4.09	4.17	4.25	4.34	4.42
1.20	4.51	4.59	4.68	4.77	4.86	4.95	5.04	5.13	5.22	5.32
1.30	5.41	5.51	5.61	5.71	5.81	5.91	6.01	6.11	6.21	6.32
1.40	6.42	6.53	6.64	6.75	6.86	6.97	7.09	7.20	7.31	7.43
1.50	7.54	7.66	7.78	7.90	8.02	8.15	8.27	8.40	8.52	8.65
1.60	8.78	8.91	9.04	9.17	9.30	9.44	9.57	9.71	9.85	9.99
1.70	10.1	10.3	10.4	10.6	10.7	10.8	11.0	11.1	11.3	11.4
1.80	11.6	11.7	11.9	12.1	12.2	12.4	12.5	12.7	12.9	13.0
1.90	13.2	13.4	13.5	13.7	13.9	14.0	14.2	14.4	14.6	14.7
2.00	14.9	15.1	15.3	15.5	15.6	15.8	16.0	16.2	16.4	16.6
2.10	16.8	17.0	17.2	17.4	17.6	17.8	18.0	18.2	18.4	18.6



Ute-32
Gilsonite
mine.
5yr 24hr.
Precip.
In tenths
of an
inch.



UTE-32
Gilsonite
Mine.
10yr
24hr
Precip. in
tenths of
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